PATENT SPECIFICATION

405,198

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COMPLETE SPECIFICATION.

Inclined Plane Railway Switch for Branching-off to the Right and Left.

I, MARTIN EICHELGRÜN, trading as MARTIN EICHELGRÜN & Co., of No. 58, Platz der Republik, Frankfurt on the Main, Germany, of German Nationality, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Inclined plane switches made of pressed sheet metal for portable railways are known, which switches, for example placed on the main track, serve as switches for branching-off to the right, and which, turned through 180° in a horizontal plane, again placed on the main track, can be used as switches for branching-off to the left. These switches are suitable for medium and heavy service for which the solidest possible sub-soil foundation is essential for the tracks.

In the case of embankments and levelling work light trucks pushed by hand are mostly used, because the loose building ground will not carry heavy loads. Main and branch lines are never on the same level in such ground, differences in height occurring in the tracks particularly when running thereover, owing to the yieldable and resilient subsoil.

In order to also satisfy these service conditions, the switch hereinafter described has been constructed, which moreover presents the advantage that adjustable direction points need not be employed and that the weight of the switch is reduced.

The feature of the new switch consists in that it can be used with the same constructional parts both for branching off to the right and also for branching-off to the left, and that the curve rails are arranged hingedly, so that each one can be easily detached separately if required. This is attained for example in that to a frog the outer curve rail is hingedly connected directly and the inner curve rail by means of a transverse element. The transverse element is hingedly connected with the frog in such a manner, that it can adapt itself to the differences in height of the individual rails. The joints allow to swing out the outer curve rail for running over the straight track and they enable further an easy detaching of the curve rails from the frog if necessary, for example when the switch has to be transported or to be reversed from branching-off to the right to branching-off to the left or vice versa.

Several forms of construction of the new inclined plane switch are illustrated in the accompanying drawing in which:—

Fig. 1 is a top plan view showing an inclined plane switch with curve rails placed on the straight track as a right hand switch for deflecting a vehicle into a branching off.

Fig. 2 shows the same switch with swung out curve rails whereby the straight continuous track is liberated for running-through.

Fig. 3 is a perspective view showing the same switch as Fig. 1.

Fig. 4 shows the same switch arrangement as Fig. 1 but reversed as switch for branching-off to the left.

Fig. 5 is a section on line *a—b* of Fig. 1.

Fig. 6 is a section on line *c—d* of Fig. 1.

Fig. 7 is a section on line *e—f* of Fig. 1, showing the connection of the frog with the rail of the branch track.

Fig. 8 is a section on line *g—h* of Fig. 1.

Fig. 9 is a section through the outer curve rail of the switch taken on line *i—k* of Fig. 1.

Fig. 10 is a section on line *l—m* of Fig. 1.

Fig. 11 is a section on line *n—o* of Fig. 1 showing the construction of a hinge point.

Fig. 11*a* is a top plan view of a hinge point with slot for a bayonet joint.

Fig. 12 shows a modified form of construction of a frog.

Fig. 13 is a section on line *p—q* through the frog illustrated in Fig. 12.

Fig. 14 shows a further modified form of construction of the frog.

Fig. 15 is a diagrammatic view of a switch employing a frog according to Fig. 14 as right-hand switch.

Fig. 15*a* is a diagrammatic view of a

[Price 1/-] Price 4s 6d.

switch employing the frog according to Fig. 14 as left hand switch.

Fig. 16 shows a right-hand switch with gauge connections hingedly arranged on both ends on the curve rails and two transverse elements.

Fig. 17 shows the switch illustrated in Fig. 16 but placed on as left hand switch.

Fig. 18 shows the switch illustrated in Fig. 16 with swung-out curve rail for running over the switch in the straight track.

Fig. 19 shows a frog with transverse element for a switch according to Figs. 16, 17, 18.

Fig. 20 is a section on line *t*—*u* of Fig. 19.

Fig. 21 is a section on line *v*—*w* of Fig. 19 taken through a roller joint of the transverse element,

Fig. 22 shows a ramp of the frog according to Fig. 18.

Fig. 23 is a section on line *x*—*y* of Fig. 22.

Fig. 24 is a section on line *a*—*z* of Fig. 22.

Fig. 25 is a section on line y_1—*b* of Fig. 22.

Fig. 26 shows a section through a roller joint taken on line *v*—*w* of Fig. 19 or x_1—*c* of Fig. 22 or *a*—*b* of Fig. 1.

Fig. 27 shows a ball joint with bayonet joint for fitting the upper part of the joint on the lower part.

Fig. 28 shows the same ball joint as Fig. 27, the upper part of the joint being already placed on the lower joint part and the transverse web of the bayonet joint extending parallelly to the slot in the upper part.

Fig. 29 shows the position of the parts after the upper part has been turned through 90° from the position illustrated in Fig. 28 thereby closing the bayonet joint.

Fig. 30 shows a switch of similar construction to that illustrated in Fig. 3, but with supporting of the curve rails by lateral flaps on the track rails and with division of the frog by a roller joint, the transverse element resting rigidly on the track rails.

Fig. 31 is a section of the outer curve on line *d*—*w* of Fig. 30.

Fig. 32 is a section of the inner curve on line *c*—*v* of Fig. 30.

Fig. 33 is a perspective view of the end of the inner curve illustrated in Fig. 30.

Fig. 34 is a section of the connection of the outer curve rail with the frog taken in the hinge point on line *f*—*u* of Fig. 30.

Fig. 35 shows the shape of the traverse element and how the same bears on the rails.

Fig. 36 shows one half of the frog of the switch illustrated in Fig. 30.

Fig. 37 shows the other half of the frog of the switch illustrated in Fig. 30.

Figs. 38, 39 and 40 are cross sections through the joint of the frog taken in the direction *g*—*t* with the halves of the frog in different mutual angle positions.

The new switch in the basic form shown in Fig. 1 consists of an outer curve rail 1 and an inner curve rail 2 which may for example be pressed from sheet metal. Both curve rails 1 2 are connected by means of joints 3 and 4 with a frog 5, so that the curves 1 and 2 can be swung as shown in Figs. 2. Owing to this possibility of swinging the curve rails 1, 2, the vehicle, as shown in Fig. 1, can climb on to the curves 1, 2 the ends of which are constructed as ramp tongues and branch off to the right over the frog 5 into the turn-out track 111, 112. If the curves 1, 2 are swung into the position shown in Fig. 2 the vehicle can run over the straight main track 113, 114.

As the rails of the tracks, especially in the case of portable railways, are mostly not laid on flat ground and therefore show differences in height in service. the curve rails 1, 2 are connected to the frog 5 by ball joints 3, 4 or 13 14.

The ball joints 3 or 4 are for example constructed as upwardly pressed ball cups and ball hoods. Figs. 27, 28 and 29 show the construction on an enlarged scale. The ball hood 4 (Fig. 27) pressed upward from the frog is provided with a transverse web 15 such as usually employed in bayonet joints. This transverse web 15 can as shown in Fig. 27. be formed by cutting out two sheet metal flaps from the ball hood 4 or by riveting therein a bolt with transverse ends. The ball cups 44 of the outer curve 1, 4, 13 and of the inner curve 2, 3, 14 (Figs. 11, 27. 28 and 29) which are rotatable on the ball hood 4, have an elongated slot 16 (Figs. 11*a*, 27, 28, 29). The outer curve 1 or the inner curve 2, according to whether the switch is to serve for branching off to the left or to the right, is slipped by means of this slot 16 over the web 15 of the ball hood 4 (Fig. 28) and then turned through 90° (Fig. 29), so that the ball joint cups 44 engage under the transverse webs 15 of the ball joint. The ball joint points illustrated in Figs. 27, 28 and 29 can be made reversed, in that the two pressings, i.e. ball hood and ball cup open in upward direction and the transverse web of the ball cup is downwardly directed.

By means of this connection described by way of example the outer curves 1 and 2 can be quickly and securely connected

with the frog 5 and the transverse element 6 so that they are articulated. The connection however presents the advantage that it is easily detachable so that the outer curves 1 and 2 can be quickly detached from the joint connection when the curve rails are to be taken out of position and brought into another position for changing the running direction.

The ball joint arrangement above described can be also simplified in order that it can be still more quickly fitted and removed, if the arrangement of the curve rails and of the frog is well supported as illustrated in Fig. 30. The ball hood, instead of the bayonet joint proper, can then be placed over the ball cup in any position, and instead of the bayonet web only a simple pin 60 of sufficient length (see Figs. 35, 38, 39, 40) need be passed through a slot 61 in the frog halves. The favourable supporting and resting of the curve rails and of the frog parts ensures that, when being run over, the upper parts of the joints with the simple pin is sufficiently guided and held against dropping out.

A transverse element 6 is hingedly connected to the frog 5 and the inner curve 2 is hingedly connected to this element. The transverse element 6 is connected with the frog 5 by a roller joint 7, which allows the element 6 and the inner curve 2 hingedly connected thereto to move vertically but prevents them from moving horizontally, so that, in spite of the movability of the switch *k* a displacement of the inner curve 2 relative to the outer curve 1 can take place in the centre of the radius. The roller joint 7 is illustrated more clearly in Fig. 26. The end 22 of the frog 5 is curved upwards and the end 190 of the transverse element 6, curved in a similar manner rests on this curved portion 22. A suitable slot 202 is provided in the curved portion 22, below which a curved iron plate 17 is provided. This curved iron plate 17 and the curved portion 190 are held apart by a bolt 7. The curved portion 22 can therefore turn relative to the curved portion 190 along its periphery.

Grooves 26, 27 are pressed in the frog 5 and serve for guiding the flanges of the truck wheels on to the frog 5 and on to the outer curve 1 (Fig. 8). A groove 8 is also provided in the frog 5 for allowing the passage of the truck wheel rim when running over an the straight track (Fig. 5 left).

The above described roller joint 7 lies parallel to the straight main track 113, 114. The same hinge effect can also be obtained if, as shown in Fig. 30, the roller joint is arranged in a plane perpendicular to the direction of travel of the straight track. In this construction the transverse element 55 is supported by resting on the rail 114 of the straight track and also on the rail 57 of the branch track (Fig. 35). The transverse element 55 then forms a supporting point for the two hingedly connected frog halves 58 and 59 and the end of the inner curve 2 with the joint 3 (Fig. 30). The roller joint is illustrated in detail in Figs. 36 and 37 and by the cylindrical element 38 in Fig. 35. The cross sections in Figs. 38, 39 and 40 show how the two halves 58 and 59 of the frog can swing over the round portion of the transverse element 55.

As, when running over the outer rail 1 in the branching off position shown in Fig. 1, it is necessary to run over the groove 8 in the frog 5, the outer curve 1 has an extension 9 beyond the pivot point 4 bridging the groove 8 in the branching off basic position.

If the curve rails are in the branching-off position illustrated in Fig. 30 the ends of the curve rails bear on the main rails 113 and 114 of the track and the other end of the outer rail 2 bears on the rail 57. For locking the rails in position when transmitting the wheel pressure during the running over, the curve rails 1 and 2 have lateral supporting flaps 50 and 51 (Figs. 31 and 32) which bear against the rail heads of the straight main track 113, 114. Thus, the running over of the switch is made more reliable by the curve.

For further securing the position of the ends of the curve rails 1, 2, especially of the inner curve rail 2, the base of the running groove 52 is laterally bent outwards in such a manner that its downwardly bent corner 53 engages under the head of the rail 114. In order to attain this effect also when the switch is being run over, the running surface 54 (Fig. 33) is laterally bent down at an incline 55 so that the curve rail 2 is always compelled by the wheel pressure to bear against the inner edge of the rail head 114 and thus press with its corner 53 under the rail head 114. For arresting the outer curve rail swung out into the position illustrated in Fig. 2, a projection 10 is provided on the frog 5 as shown in the section illustrated in Fig. 5. The running surface of the curve rail 1 pressed in U-shape engages over this projection 10, so that the rail 1 is securely held in the position shown in Fig. 2 between the rails 113 and 114 of the straight track.

In order to prevent the branching rails 1, 2 from slipping when being run over, a pin 11 provided with a handle bent at an angle is arranged on the frog 5 which

pin extends through holes in the vertically downwardly pressed arms 12 (Fig. 7) of the frog.

The pin 11 with an upwardly projecting arm is passed through the holes in the frog and web of the rail 111. The pin is then turned and engages in the ramp groove 26 so that a secure connection is produced between the frog and the rail 111.

The outer curve rail 1 and the inner curve rail 2 are constructed symmetrically at their ends, being also fitted at their opposite ends with joint cups 13, 14 (Fig. 1). The frog 5 is likewise constructed symmetrically with the axis *a*—*b* (Fig. 1) extending perpendicularly to the main track as symmetry axis. Owing to this construction it is possible to turn the two rails 1, 2 and the frog 5 through 180° in a horizontal plane and to place them on the opposite rail 113 of the main track. It is merely necessary to detach the outer rail 1 and the inner rail 2 from the frog 5 in the joints 3 and 4, and after the turning of the frog to again connect them with their oppositely arranged points 13 and 14 to the frog joint and to the transverse element 6. The switch can then be employed as left turn-out switch as illustrated in Fig. 4.

The construction of the frog illustrated in Figs. 1, 2, 3, 4 and 30 requires, when changing the switch from right to left turn-out, the turning of the frog through 180° in a horizontal plane (Fig. 1 or 4). This turning of the frog can be avoided if the frog is constructed also symmetrically to its axis *a*—*b*, parallel to the main track. Such a construction is illustrated in Fig. 12. In this construction of the frog provision is made from the beginning for branching-off to the right or to the left by the ribs 31 and 32.

Consequently, only two ball joints 33 and 34 are provided for changing the connection of the curve rails 1, 2 and two roller joints 7 for connecting the transverse element 6 for the inner curve rail 2. In the section on line *p*—*q* in Fig. 13 is shown, how the frog is placed on the continuous main track rail for a switch branching-off to the right or to the left. This turning of the frog is not necessary in this construction when changing the branching-off direction of the switch.

The construction of the frog illustrated in Figs. 1 to 4 and 12 can be also simplified by providing only two pressings 29 and 30 as shown in Fig. 14 for forming the angle of the turn-out direction instead of double pressings as at 26 and 27 in Fig. 4 or at 31 and 32 in Fig. 12. It is true that the frog becomes smaller thereby. In the frog shown in Fig. 4 it is necessary, when changing the switch from right to left turn-out, to turn the frog through 180° in a horizontal plane, whereas in the arrangement of the simpified frog as shown in Fig. 14 the frog is turned through 180° plus the turn out angle of the switch (see Figs. 15 and 15*a*).

Figs. 16, 17 and 18 show a form of construction of the switch in which two frogs and two transverse elements are provided. These switches need not be taken to pieces when changing from right to left turn-out. The transverse element 18 is attached to the inner curve rail 2 by means of the already described ball joint 26, and at its other end to a roller joint 7 (see section x_1—c Fig. 26 and Fig. 18), which is constructed in detail exactly similar to the roller joint illustrated in Fig. 5.

The frogs A and B, as shown in Figs. 18 and 19, consist of a part 19, which rests on the branch rail 111, and of a part 201 resting with its groove 20 on the rail 114 of the straight track. The part 201 forms one piece with the transverse element 18. The frog can turn around the roller bearing 7, around axis *a*—*b* out of the horizontal plane. At the same time the part 201 resting on the straight main rail 114 can tilt towards both sides out of the horizontal plane, in order to thus adapt itself to any variations in height of the rail 114 situated thereunder. The transverse element 18 being connected to the part 201 of the frog (Fig. 19) enables the same frog arrangement to be provided also on the other ends of the outer curve. For this purpose it is necessary for the transverse element 18 to have a pressed in groove 21 with which it rests on the main rail 114 to be run over by a wheel. This groove 21 at the same time presents the advantage that the curve rails 1, 2 are arrested in position after they have been swung out of their original position.

The construction of one of the frog parts with transverse element pressed therein is illustrated in Figs. 19 and 22. The connection of the parts 19 and 201 by roller joint is shown in the section x_1—c in Fig. 26. The part 19 has a cylindrical pressed out portion 190, which is connected to an inserted curved iron plate by means of the bolt 7. In the gap between the curved portions 17 and 190 the cylindrical pressed portion 23 of the part 201 having a slot 202 is arranged, so that the curved portions 22 and 190 can mutually rotate. The sections in Figs. 20, 21, 23, 24 and 25 show the exact shape of the individual cross sections of the pressed parts.

The connection of the curved rails at their two ends is not effected in this instance by a bayonet joint, as it is unnecessary

to detach the curve rails from the frog for changing the direction, but the ball joints are rigidly interconnected by screws so that merely one ball joint movement is possible. The reversal of the switch from a right to a left switch, which was necessary in the first described construction (Figs. 1, 2, 3, 4, 30) by detaching the curve rails from the frog and turning them through 180°, is simplified in the switch construction shown in Figs. 16, 17 and 18, in that the whole united frame construction of the switch, the parts of which are hingedly connected, is adapted to be lifted off the track and turned through 180° in a horizontal plane so far, that the frog A originally crossing the main rail as shown in Fig. 16 after being turned in the horizontal plane and again placed on the main rail (Fig. 17) now lies parallel to the main rail, whereas the frog B, formerly lying parallel to the main rail (Fig. 16) crosses the main rail as shown in Fig. 17.

As shown in Fig. 18, it is sufficient to simply lift the front transverse element 18, in order to reverse the switch from turning off to straight ahead travel, the lower groove 21 being placed on the rail 114.

The bridging of the difference in height between the straight track and the branch track is effected, in the case of switches according to Figs. 1 to 4, in that the inner curve rail 2 and the frog 5 can tilt around the rails of the straight track, so that in any case supporting on the branch track is attained. All other parts can correspondingly follow this movement owing to their being hingedly connected.

In the second form of construction of the switch illustrated in Figs. 16, 17 and 18 the inner curve rail 2 tilts around the rail of the straight track, whereas the ramp 19 tilts around the track transverse element 18.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1.—Inclined plane switch for branching-off to the right and left, characterized in that the outer curve rail (1) is hingedly and detachably connected directly with a frog (5, A, B) and the inner curve rail (2) by means of a transverse element (6, 18), if necessary each one detachable in itself.

2.—Inclined plane switch as claimed in claim 1, characterized in that the transverse element (6, 18) is connected vertically oscillatable with the frog (5, A, B) for example by means of a roller bearing (7).

3.—Inclined plane switch as claimed in claims 1 and 2, characterized in that the curve rails (1, 2) are connected to joints of the frog (5, A, B) and of the transverse element (6) by means of ball joints which may be provided with an easily detachable bayonet joint (15, 16).

4.—Inclined plane switch as claimed in claims 1 to 3, characterized in that the curve rails (1, 2) are symmetrically constructed towards both ends and have a hinge point (4, 13) or (3, 14) or (23, 25) or (24, 26) at each end.

5.—Inclined plane switch as claimed in claims 1 to 4, characterized in that the outer curve rail (1) has at each end an extension (9) extending beyond its hinge point (4, 13) and bridging the crossing frog groove (8).

6.—Inclined plane switch as claimed in claims 1 to 5, characterized in that the extension (9) forms a stop of the fundamental position of the outer curve rail (1) by cooperation with a projection (10) pressed from the supporting plate of the frog.

7.—Inclined plane switch as claimed in claims 1 to 6, characterized in that the frog has a groove (8, 37) for the passage of the wheel tyre flange for the straight track and on each side of its symmetric axis a ramp groove (26, 27 or 31, 32) and a hinge point (4, 15 or 33, 34) the symmetry axis extending perpendicularly or parallel to the rail (114) of the straight track.

8.—Inclined plane switch as claimed in claims 1 to 6, characterized in that the frog has two grooves (29, 30) converging at an obtuse angle with pressed portions situated besides these grooves, bearing on the main and branch rails and embracing the rail heads, each of these pressed portions comprising a hinge point (33, 34), and the transverse element (6) being situated in the bisecting line of the obtuse angle.

9.—Inclined plane switch as claimed in claims 1 to 7, characterized in that the frog (20) and the transverse element (18) are made in one piece and that the ramp (19) is connected with the transverse element (18) by means of a roller joint (7) the ramp (19) extending tangentially from the outer rail curve.

10.—Inclined plane switch as claimed in claims 1 to 4 and 9, characterized in that the frog (A, B) the transverse elements (18) and the ramp (19) are arranged on the two ends of the outer curve rail (1) (Figs. 16, 17, 18).

11.—Inclined plane switch as claimed in claims 1 to 4 and 9 and 10, characterized in that the transverse element (18) is provided with a groove shaped pressed

portion (21) which, placed on a main rail (114), liberates the switch for straight ahead travel and secures it in this position.

12.—Inclined plane switch as claimed in claims 1 to 11, characterized in that the switch is secured against shifting in the track by a rotatable bent bolt (11), which is inserted through the vertically downwardly directed webs (12) of the frog and through a hole in the adjacent rail, and is secured against detaching by turning its handle into the running groove (26) of the frog.

13.—Inclined plane switch as claimed in claims 1 to 6, characterized in that the curve rails (1, 2) have lateral flaps (50, 51) by means of which they bear on the continuous straight main track rails (113, 114) when the switch is run over.

14.—Inclined plane switch as claimed in claims 1 to 6, characterized in that the frog is divided into two halves (58, 59) by a roller joint (38, 60), which lies in the plane perpendicular to the continuous straight track.

15.—Inclined plane switch as claimed in claims 1 to 9, characterized in that the inner curve rail (2) has a downwardly bent corner (53) wedging under the head edges of the main rail (114) for securing the inner curve rail (2) against springing out of its position on the end (52) when being run over.

16.—Inclined plane switch as claimed in claims in claims 1 to 9 and 15, characterized in that the head (54) of the inner curve rail (2) is bent obliquely laterally on the head to afford a rigid support of the bent off corner (53).

17.—Inclined plane switch as claimed in claims 1 to 8, 15 and 16, characterized in that the transverse element (55) for connecting the outer and inner rails rests on a rail (14) of the straight track and on a rail (57) of the branch track and serves as support for the hinge point (4) of the inner curve rail (1) and as support for the roller joint of the divided frog (58, 59).

18.—Inclined plane switch as claimed in claims 1 to 17, characterized in that the halves of the ball joints and of the roller joints are mutually held in their initial position by a pin (60) which is rigidly connected with the ball cup or with the roller (38) of the bearing.

Dated this 6th day of March, 1933.

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SHEET 1

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig.1

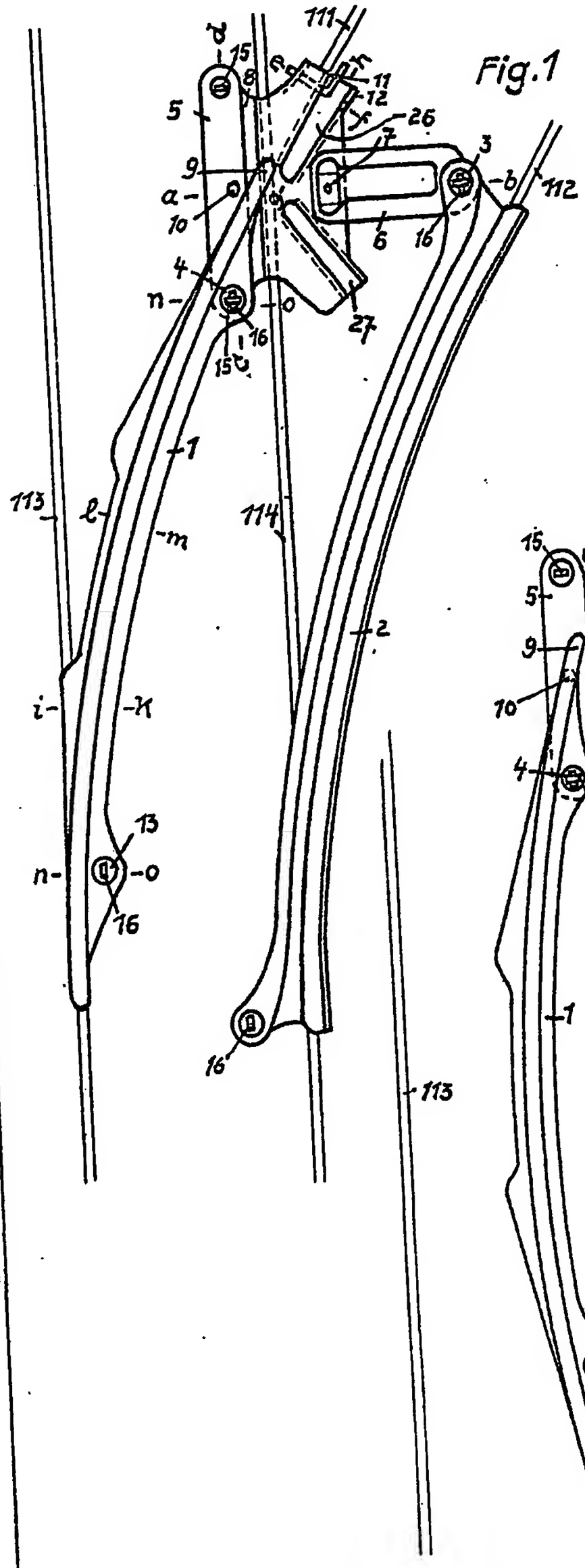


Fig.2

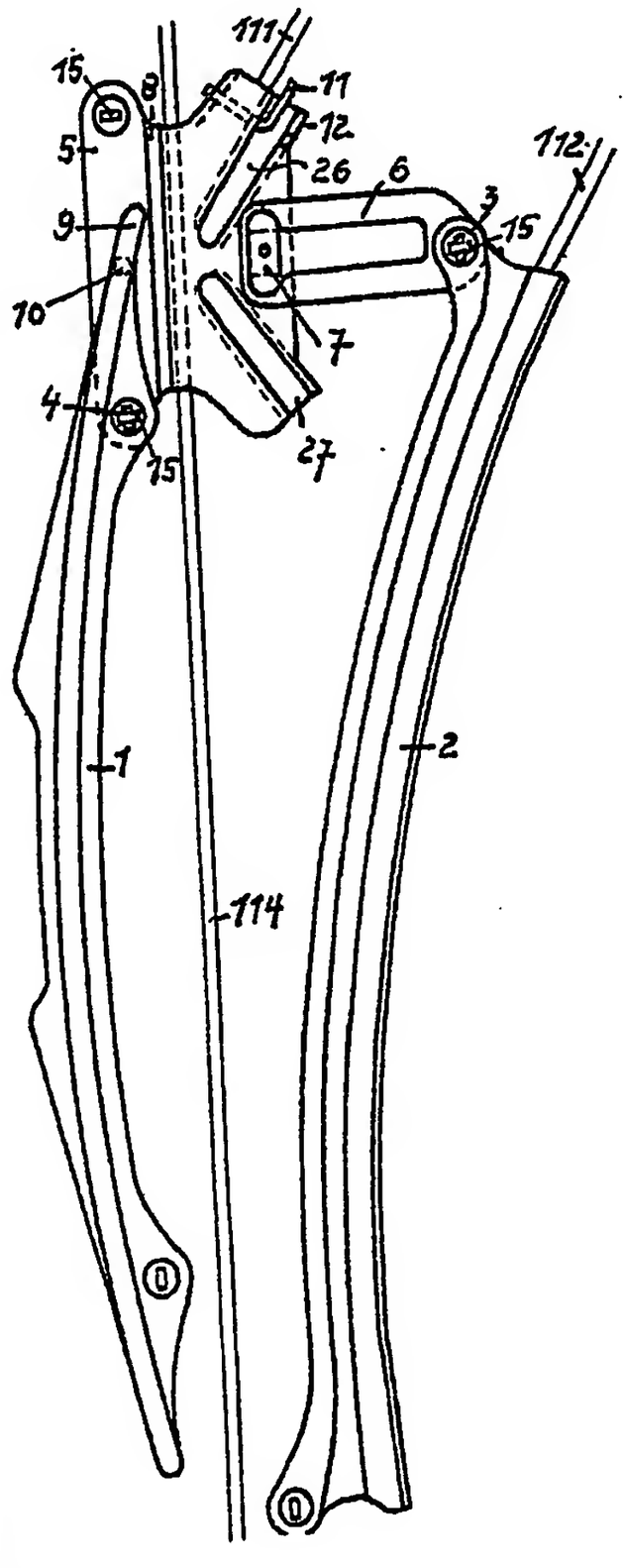


Fig.
(C-

Fig.3

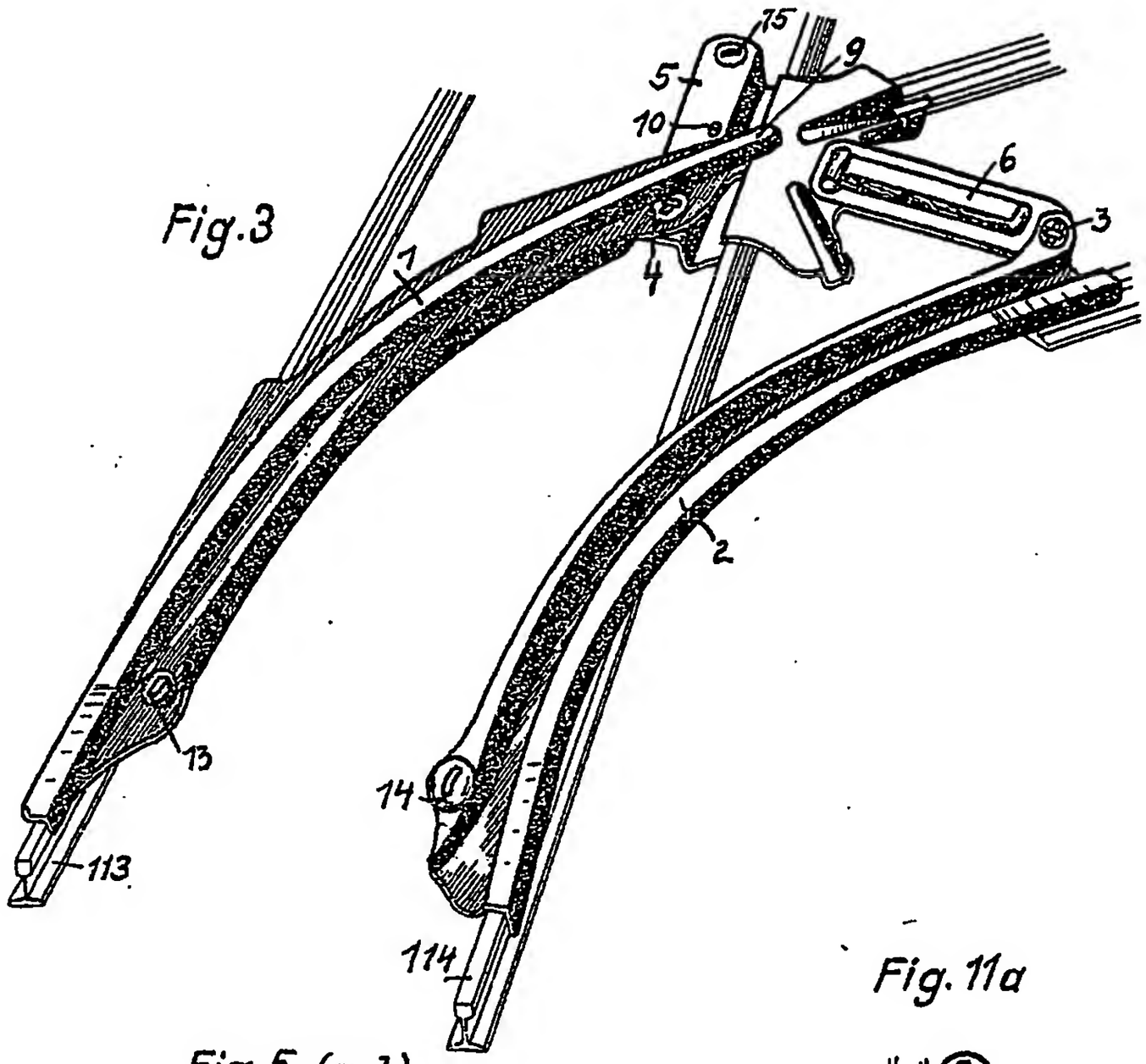


Fig.5 (a-b)

Fig.6 (c-d)

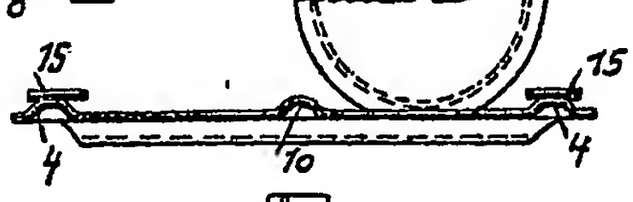
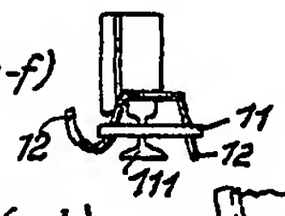


Fig.7 (e-f)



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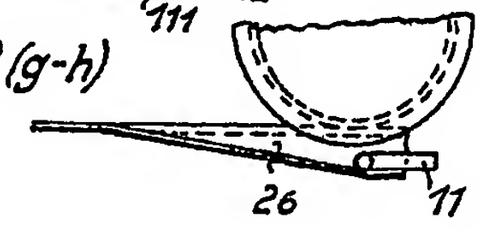

Fig.9 (i-k)

Fig.10 (l-m)

Fig.11 (n-o)

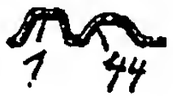

Fig.11a

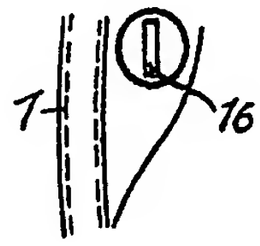

Fig.12

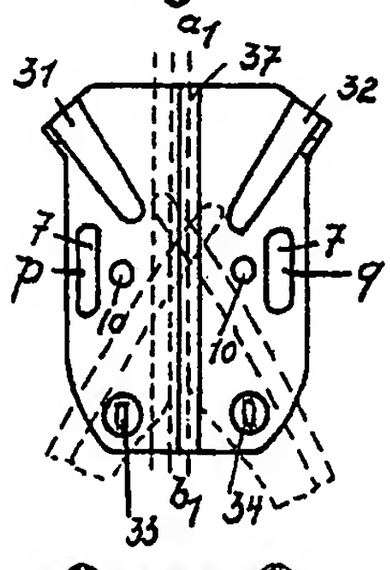

Fig.13 (p-q)

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6 SHEETS

SHEET 1

SHEET 2

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Fig.1

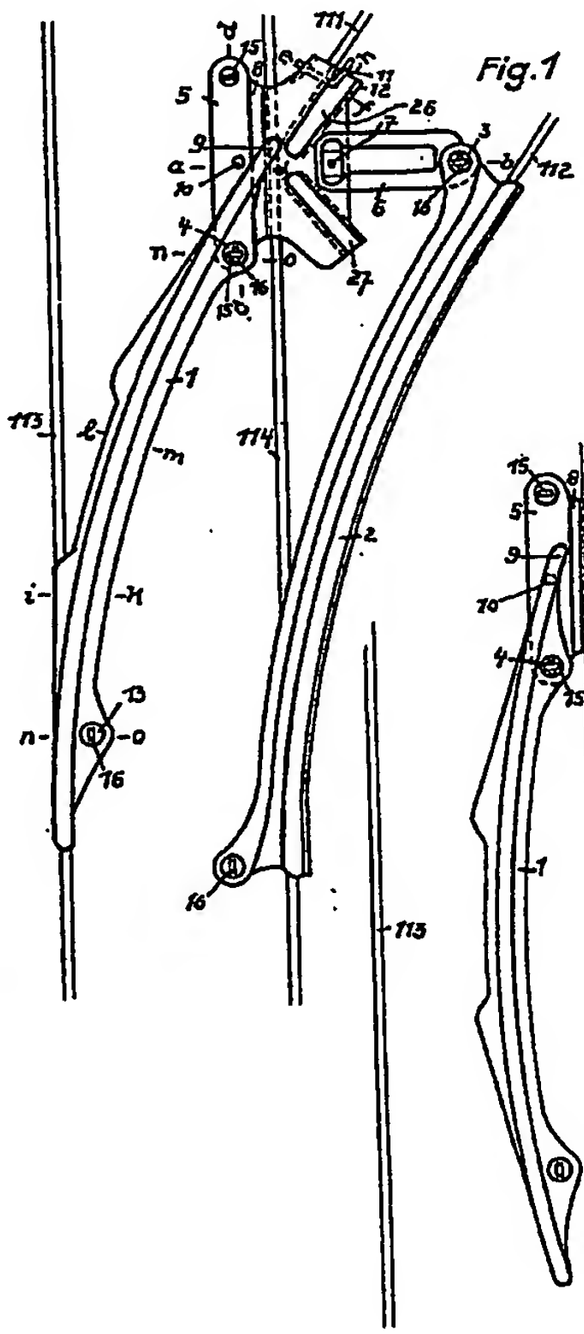

Fig.2

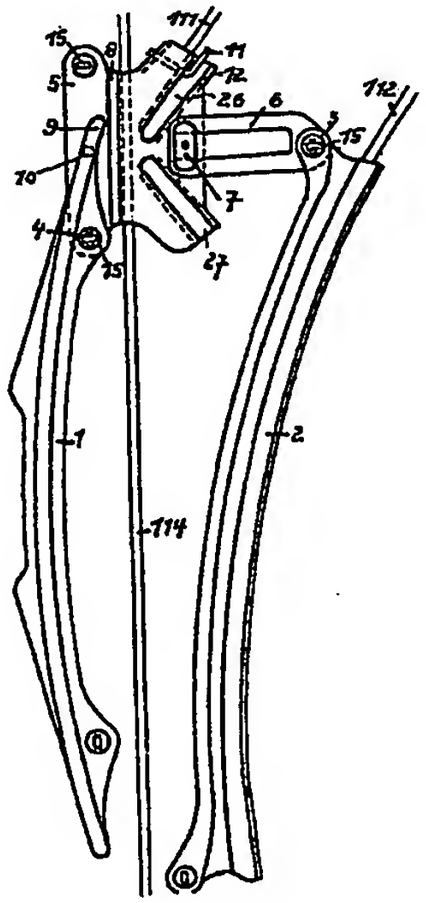

Fig.3

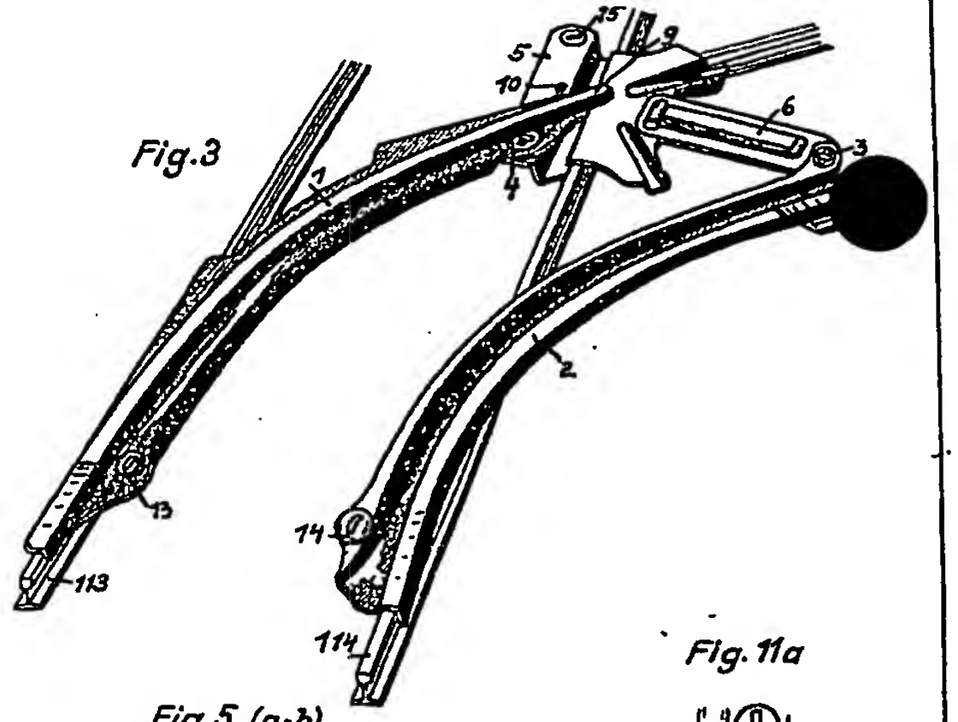

Fig. 11a

Fig.5 (a-b)

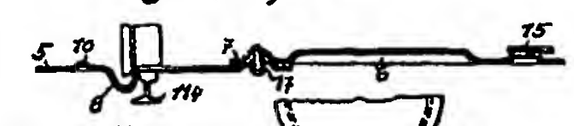

Fig.6 (c-d)

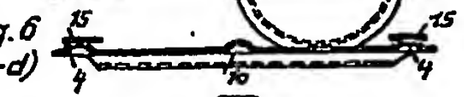

Fig.7 (e-f)

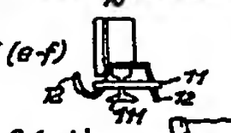

Fig.8 (g-h)

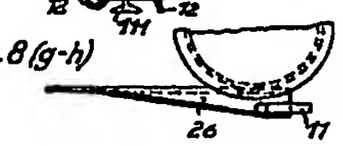

Fig.9 (i-k)

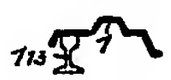

Fig.10 (l-m)

Fig.11 (n-o)

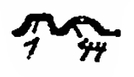

Fig.12

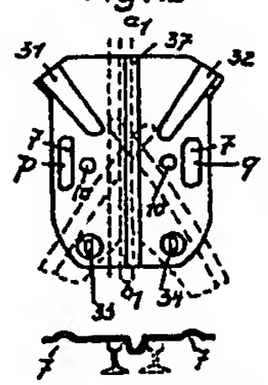

Fig.13 (p-q)

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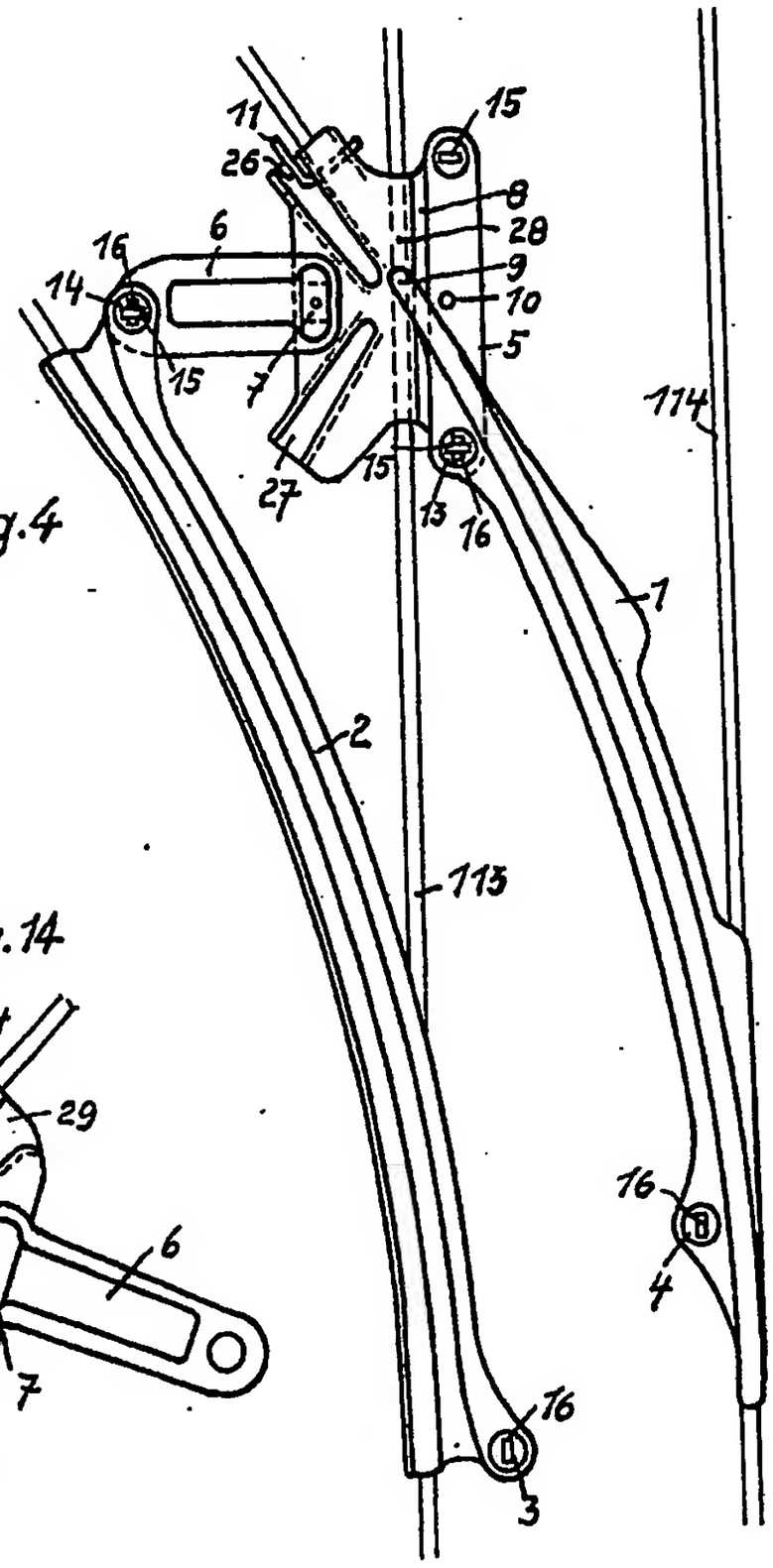


Fig. 4

Fig. 14

Fig. 15

Fig. 15a

Fig. 16

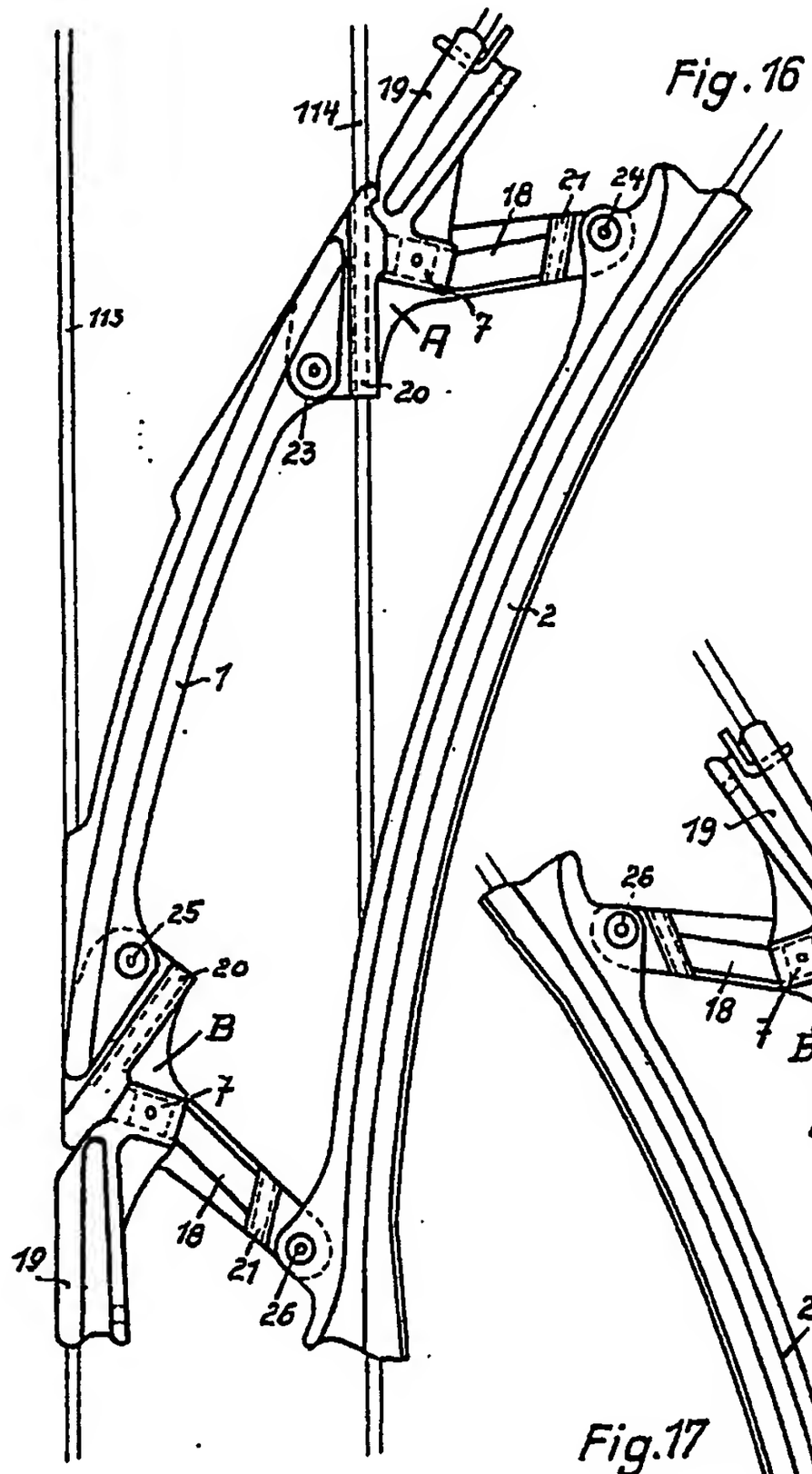
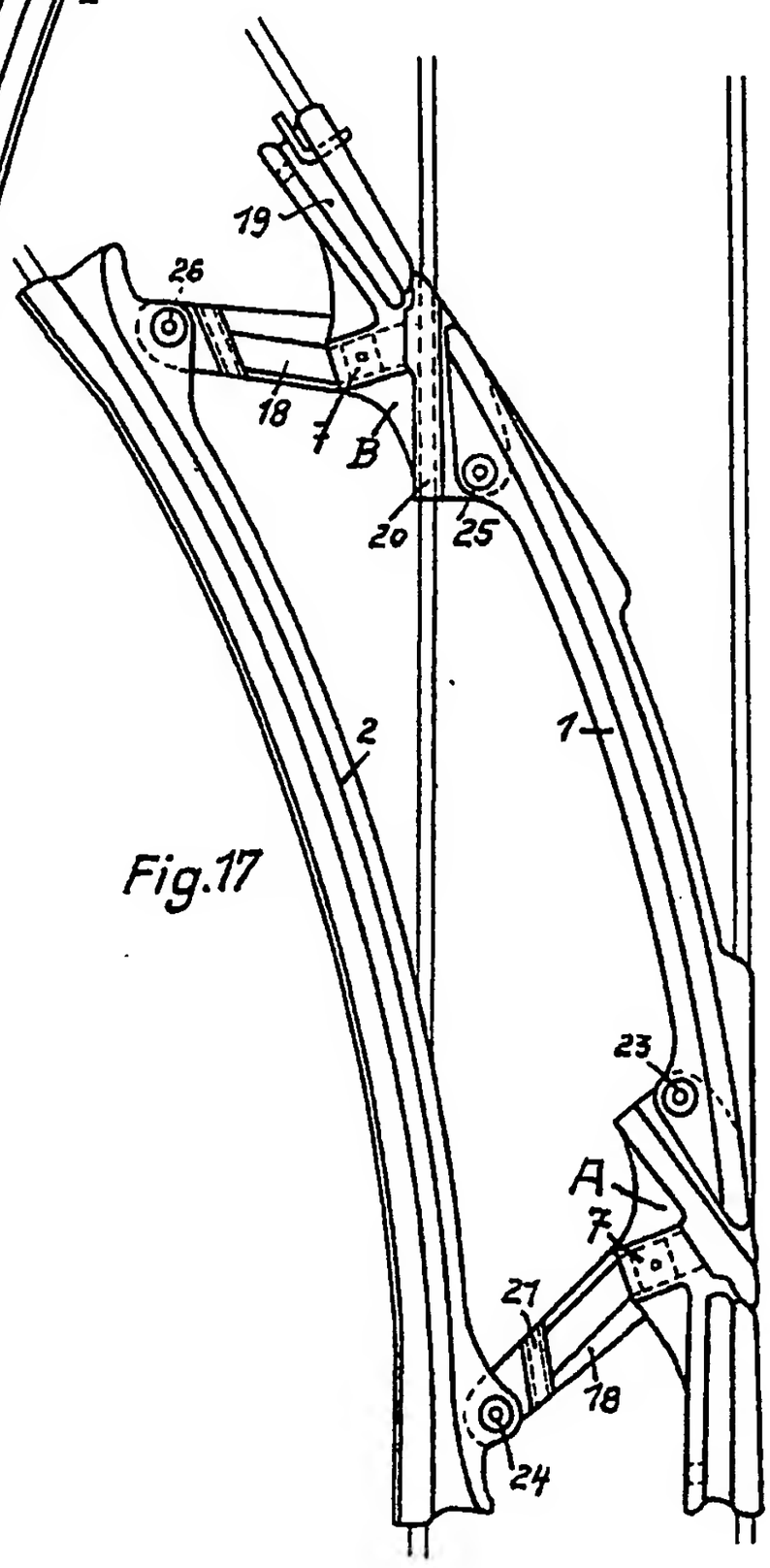


Fig. 17



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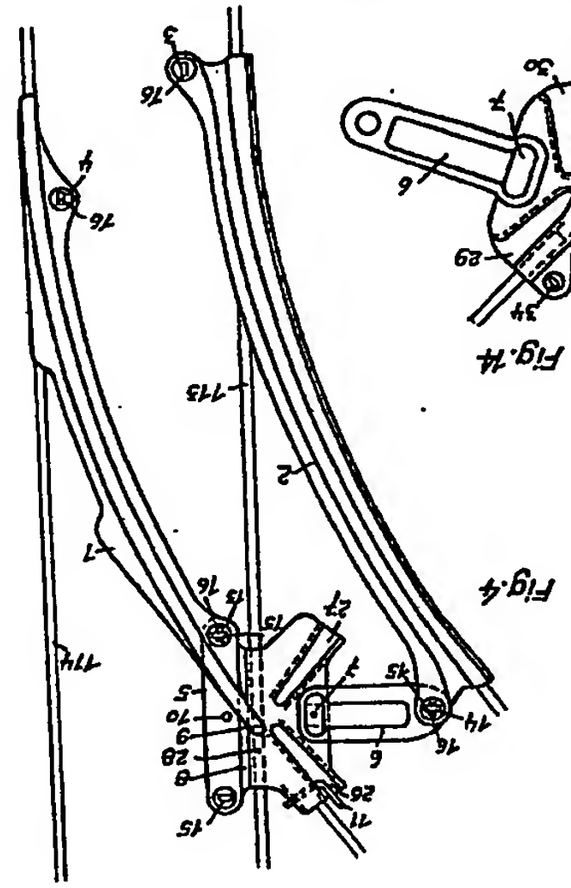


Fig. 4

Fig. 14

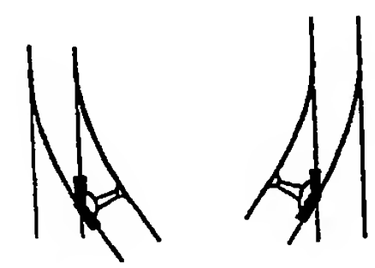


Fig. 15

Fig. 15a

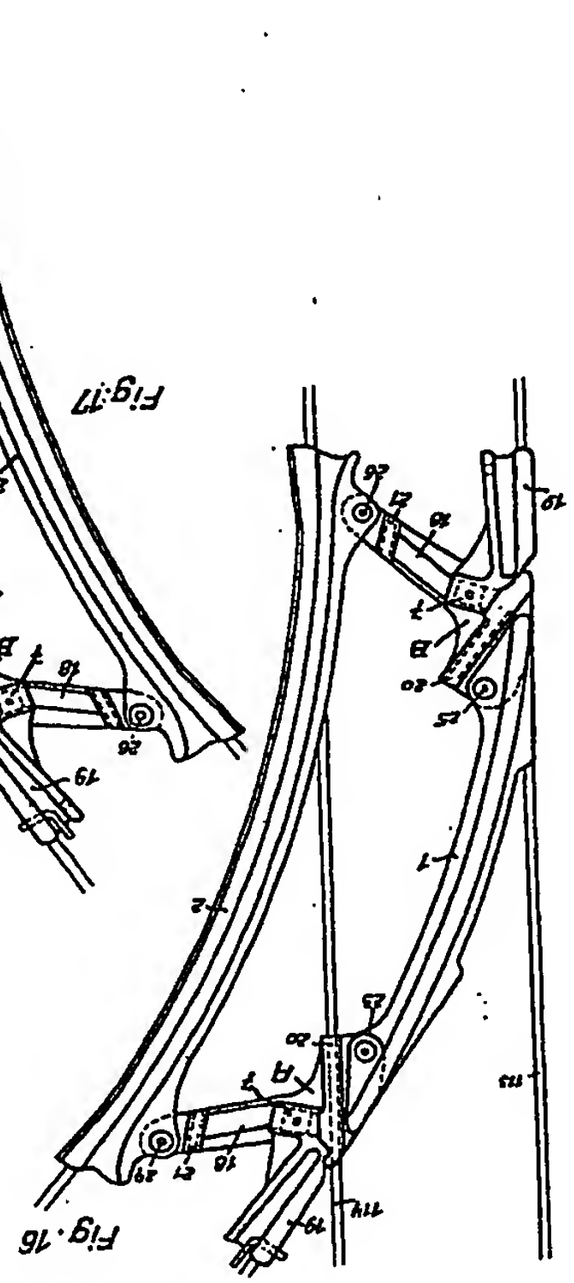


Fig. 16

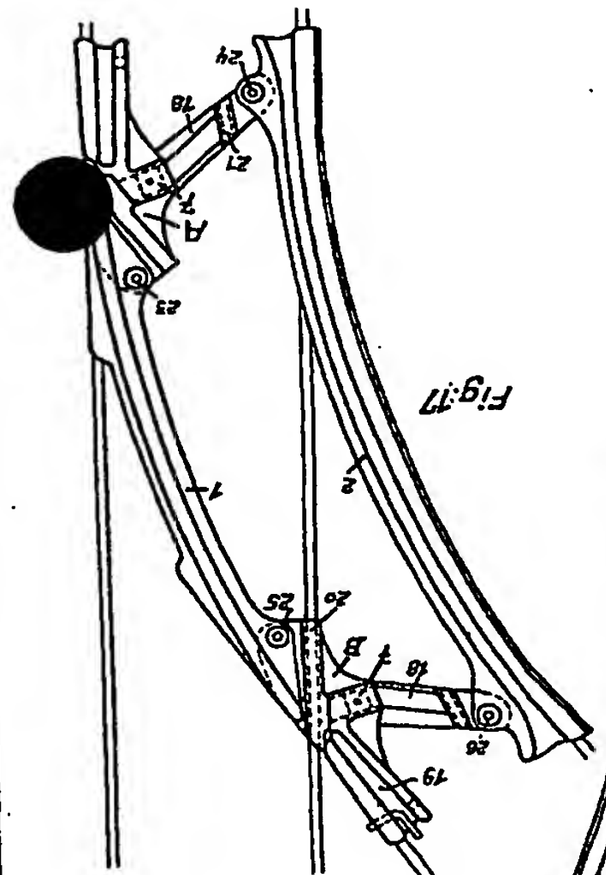


Fig. 17

Fig.18

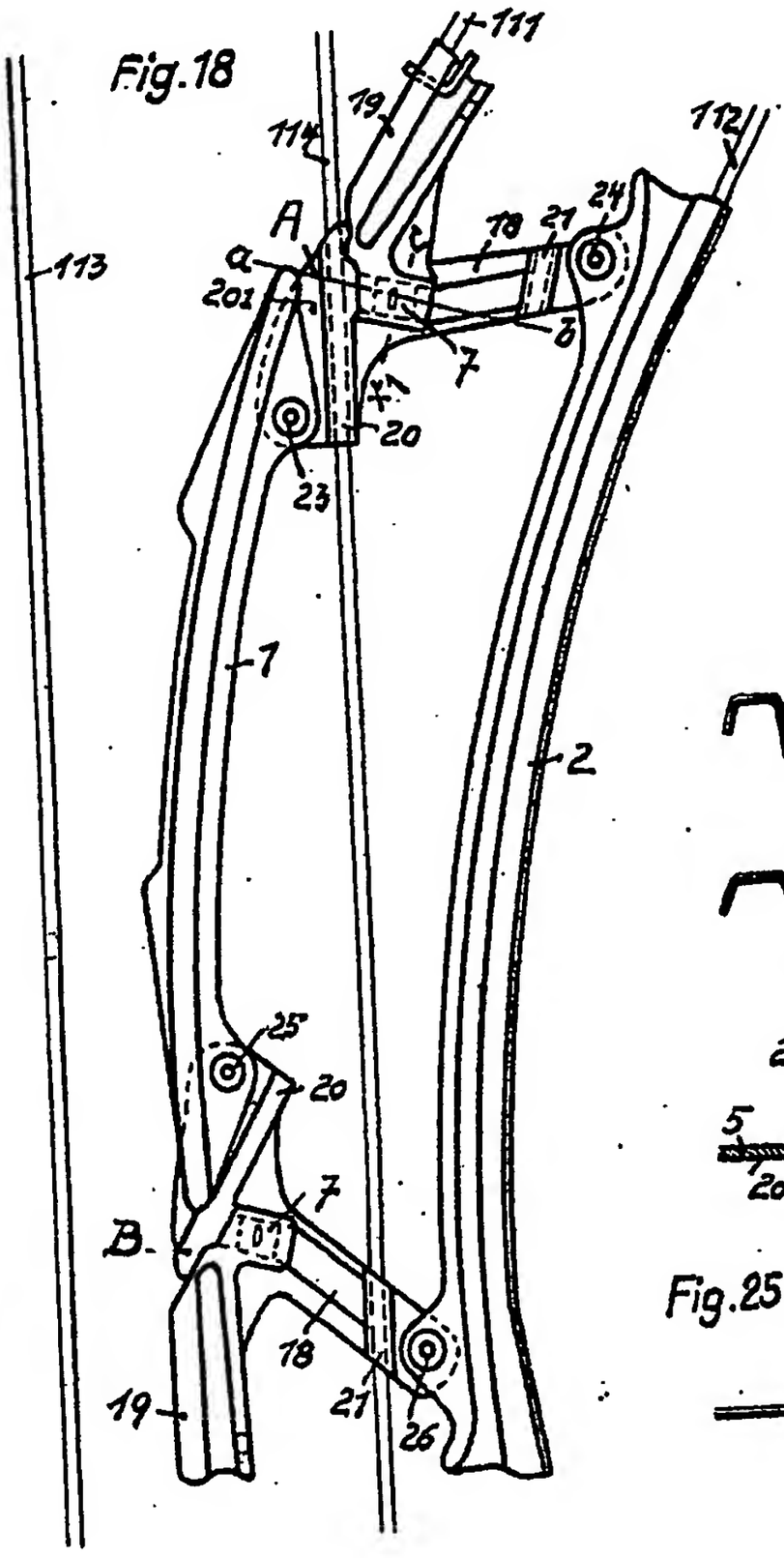


Fig.22

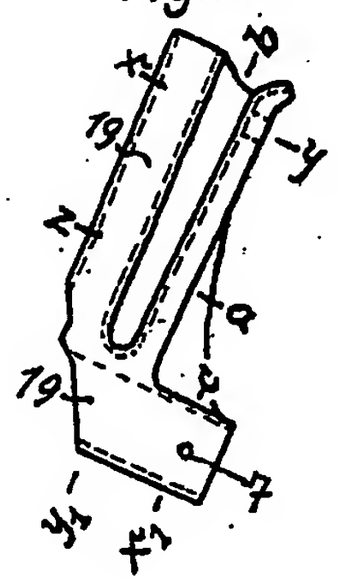


Fig.23 (x-y)

Fig.24 (z-a)

Fig.26 (x_1-a)

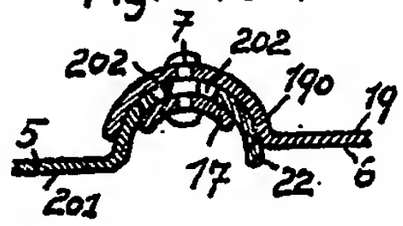


Fig.25 (y_1-b)

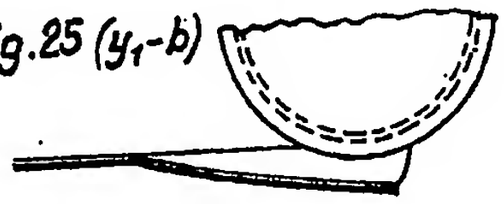


Fig.27

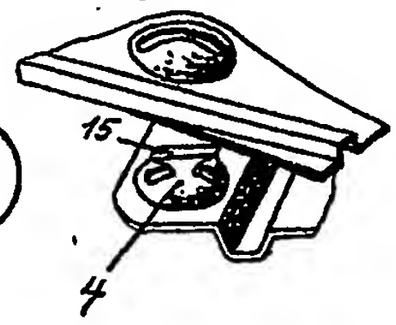


Fig.19

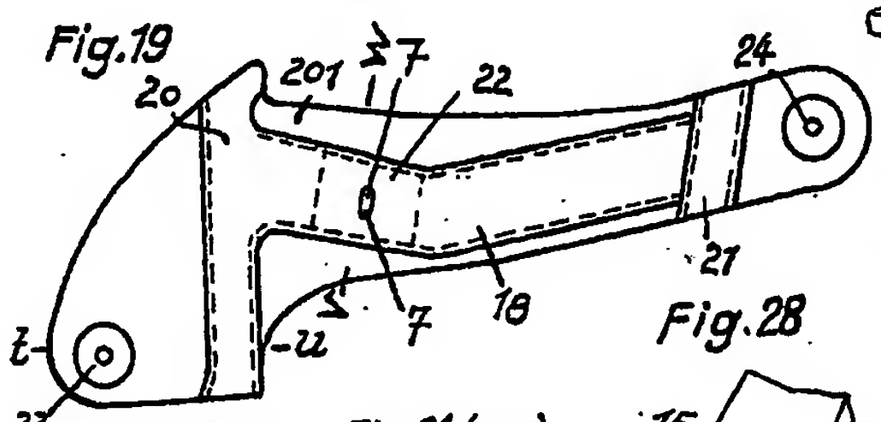


Fig.20 (t-u)

Fig.21 (v-w)

Fig.28

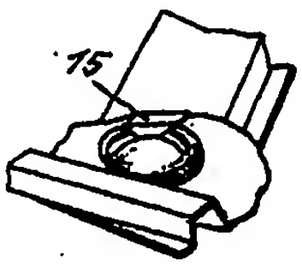


Fig.29

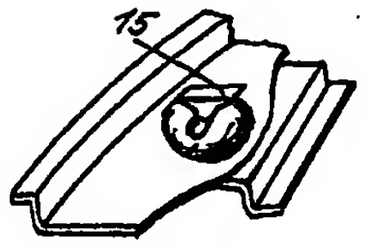


Fig.30

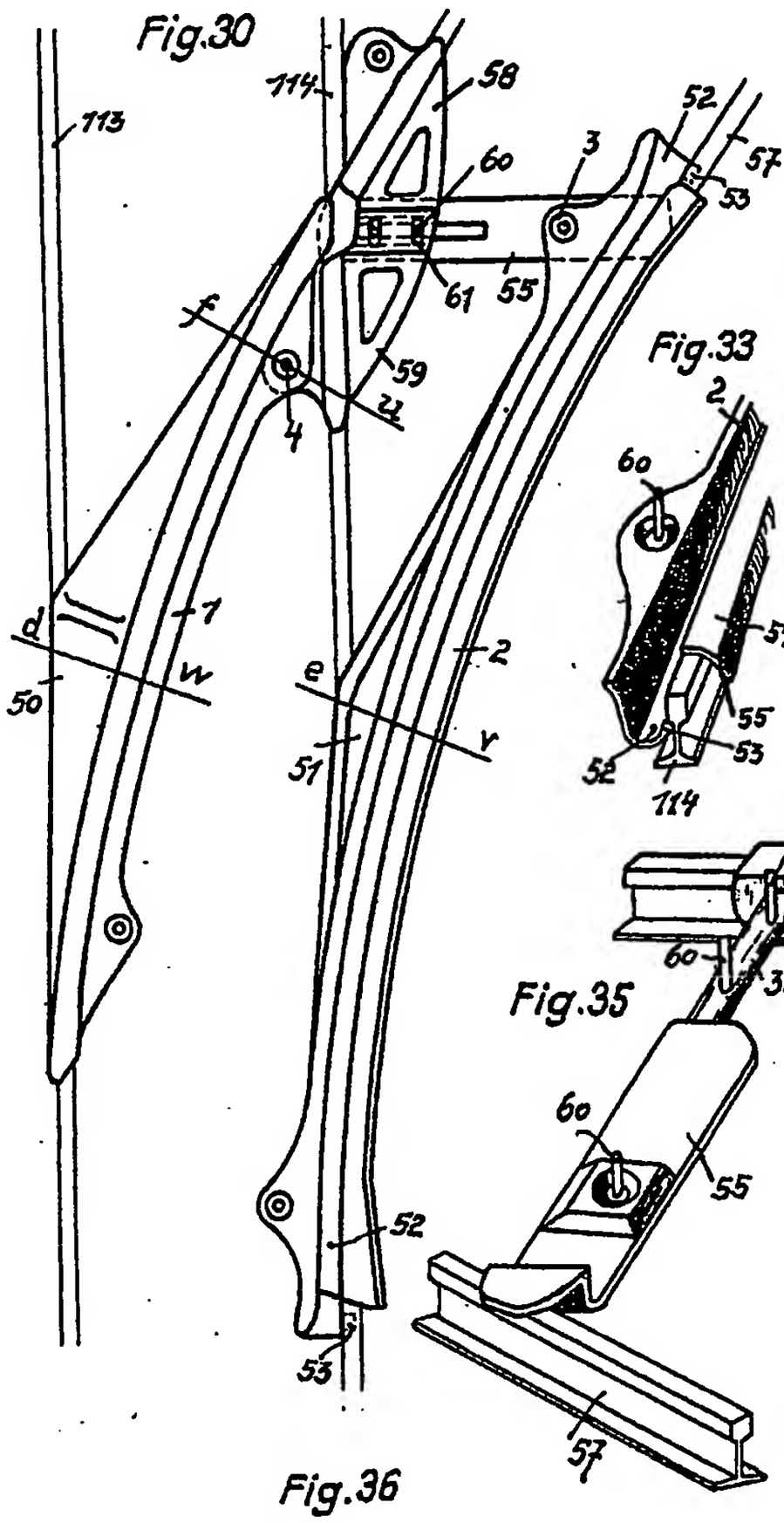


Fig.31 (d-w)

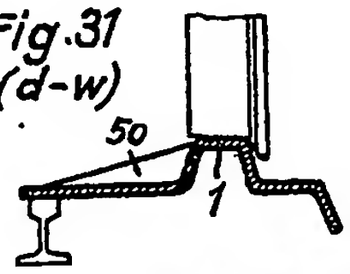


Fig.32 (e-v)

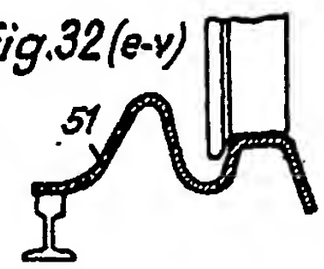


Fig.33

Fig.34 (f-u)

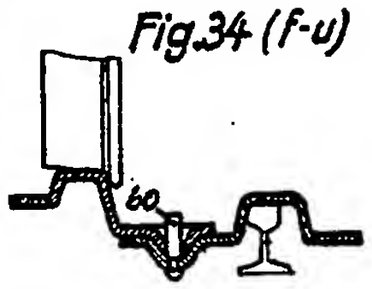


Fig.35

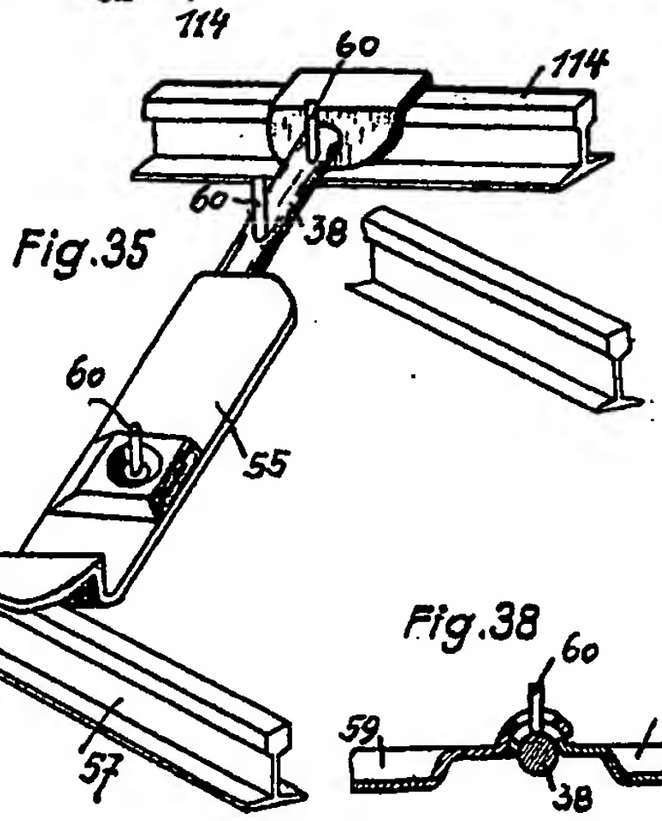


Fig.36

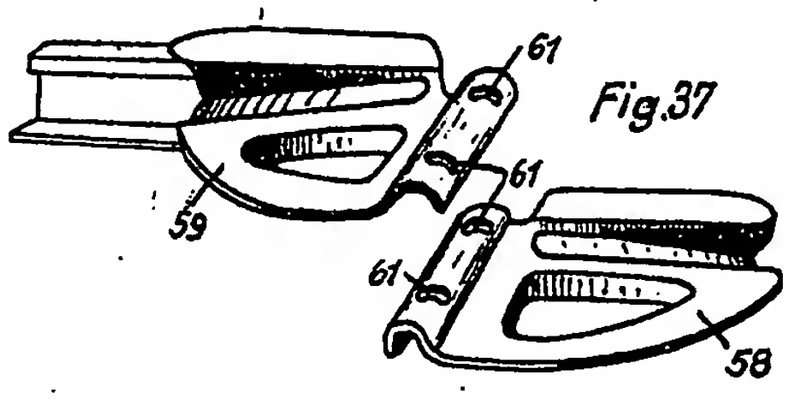


Fig.37

Fig.38

Fig.39 (g-t)

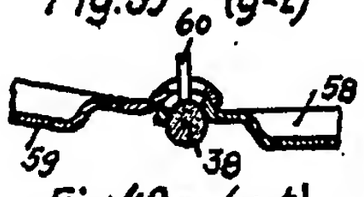
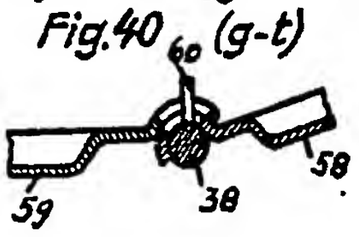


Fig.40 (g-t)



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6 SHEETS

SHEET 5

Fig.18

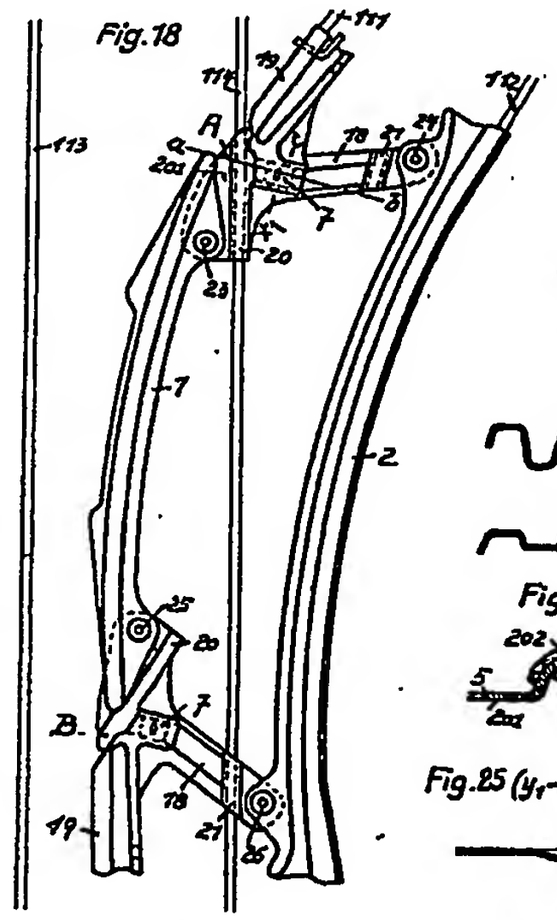


Fig.22

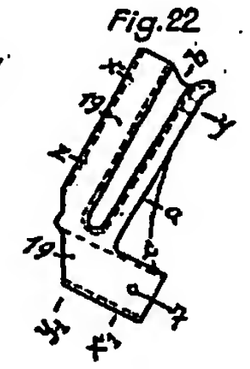


Fig.23 (x-y)

Fig.24 (z-a)

Fig.26 (x_1-a)

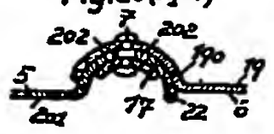


Fig.25 (y_1-b)

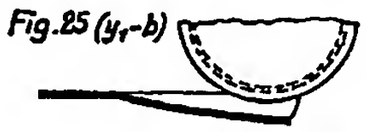


Fig.19

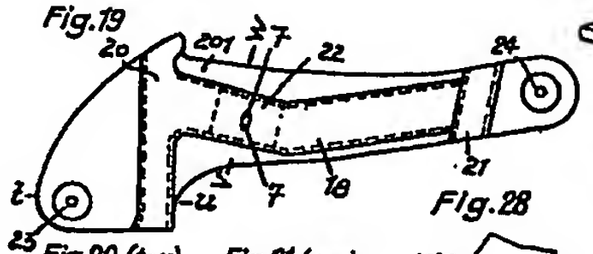


Fig.20 (t-u)

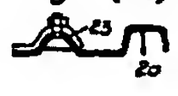


Fig.21 (v-w)

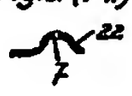


Fig.27

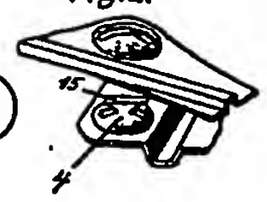
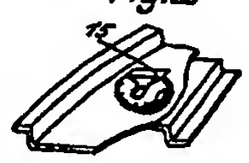


Fig.28

Fig.29



SHEET 6

Fig.30

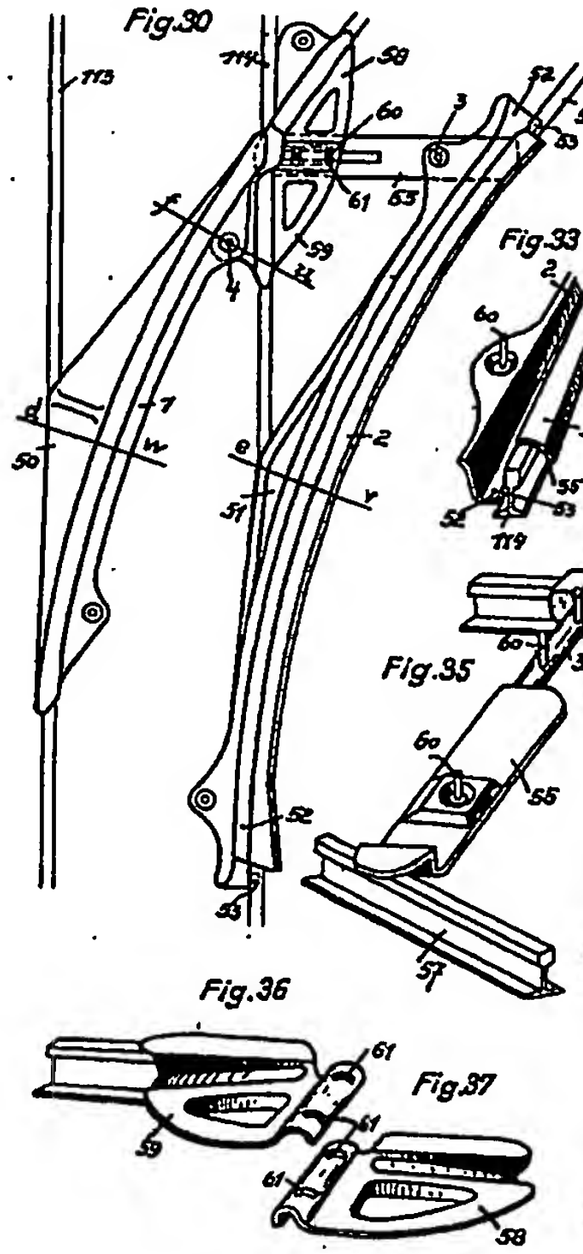


Fig.31 (d-w)

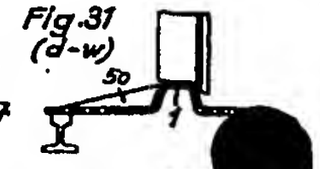


Fig.32 (e-v)

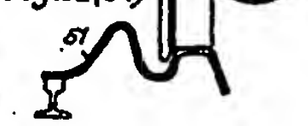


Fig.33

Fig.34 (f-u)

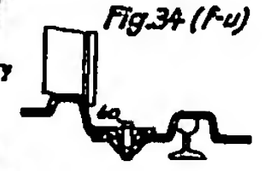


Fig.35

Fig.36

Fig.37

Fig.38

Fig.39 (g-t)

Fig.40 (g-t)

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